Factors influencing scanning for alerts

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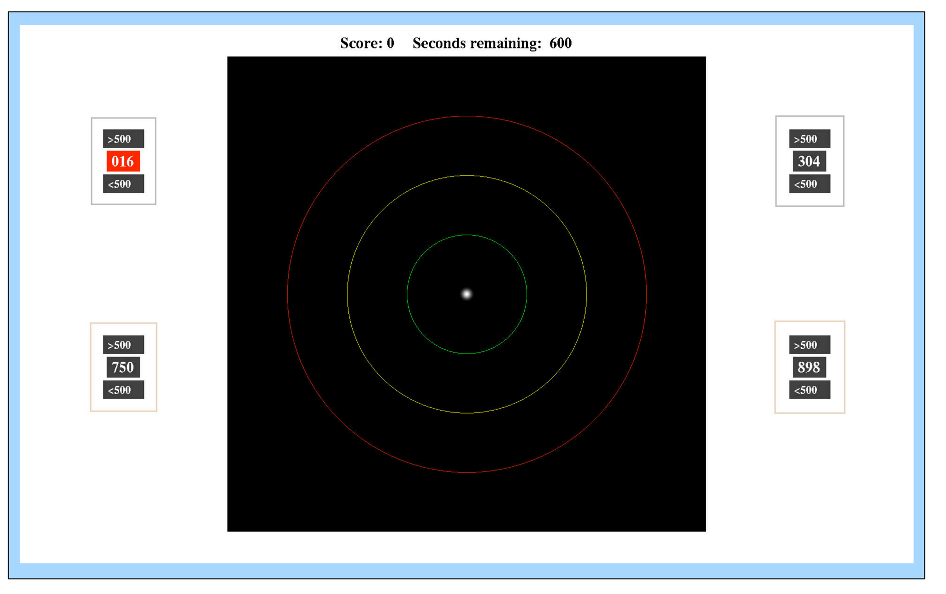
Can we predict how long it will take a working operator to notice a visual alert?

How is the visibility of peripheral targets affected by the performance of concurrent tasks?

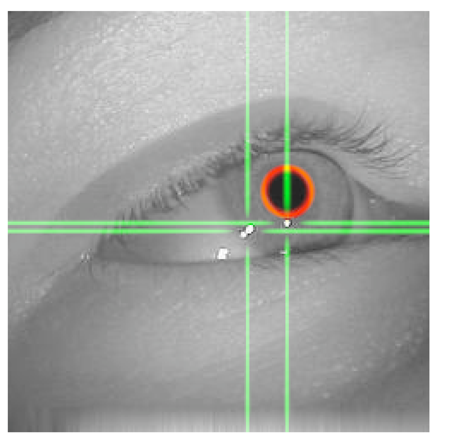
Experimental paradigm

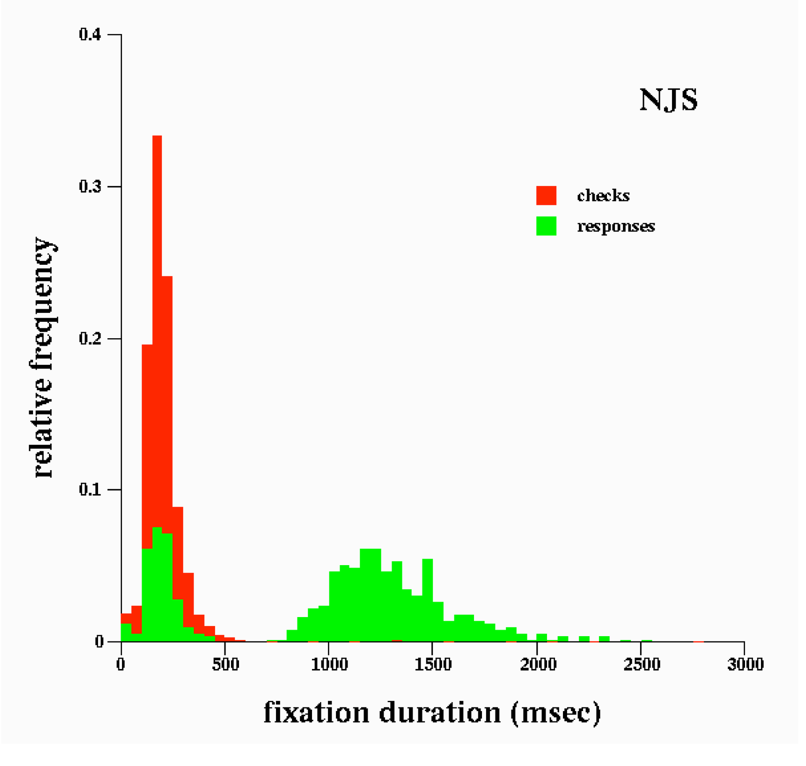
We have attempted to address these questions using an experimental paradigm in which a subject is required to perform a demanding central task while monitoring a set of peripheral locations for color change events. The stimulus layout is shown on the right. The subject uses the mouse to keep a wandering spot in the center of the arena (the black area); when a color change event is detected, the subject must make a magnitude judgment and indicate his or her response by clicking on the associated button.

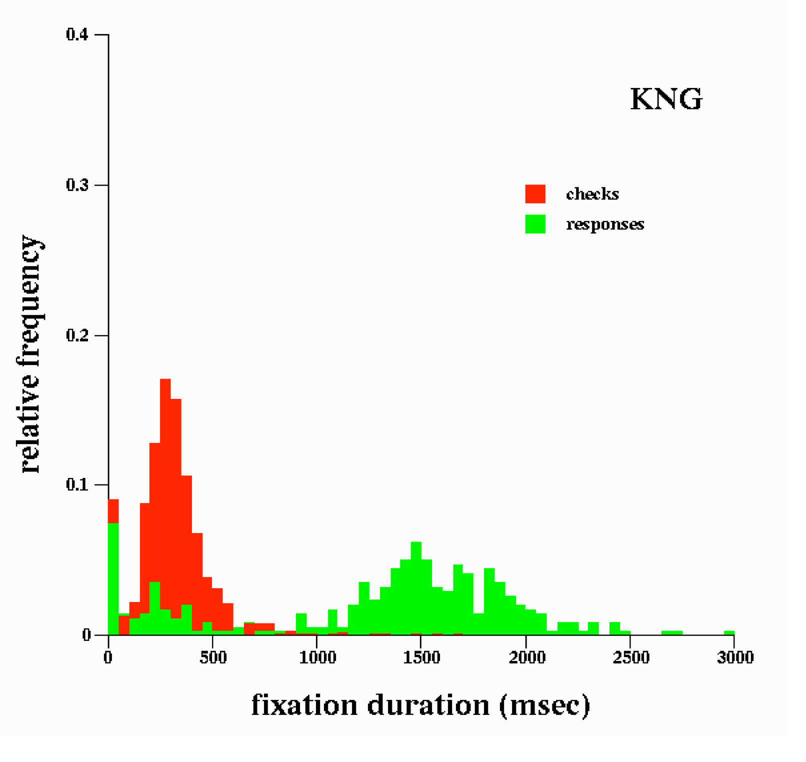


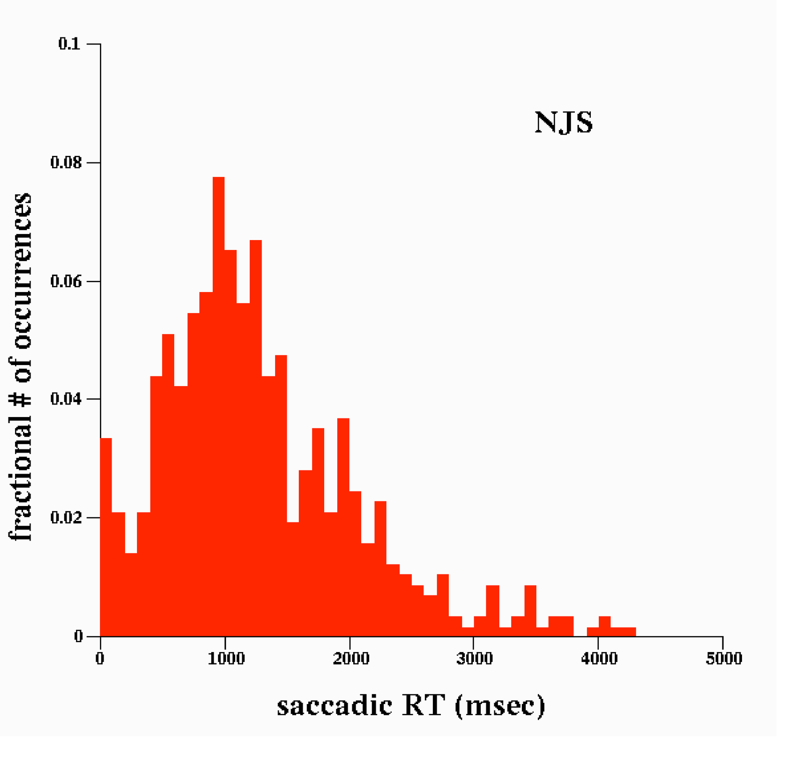
Gaze estimation

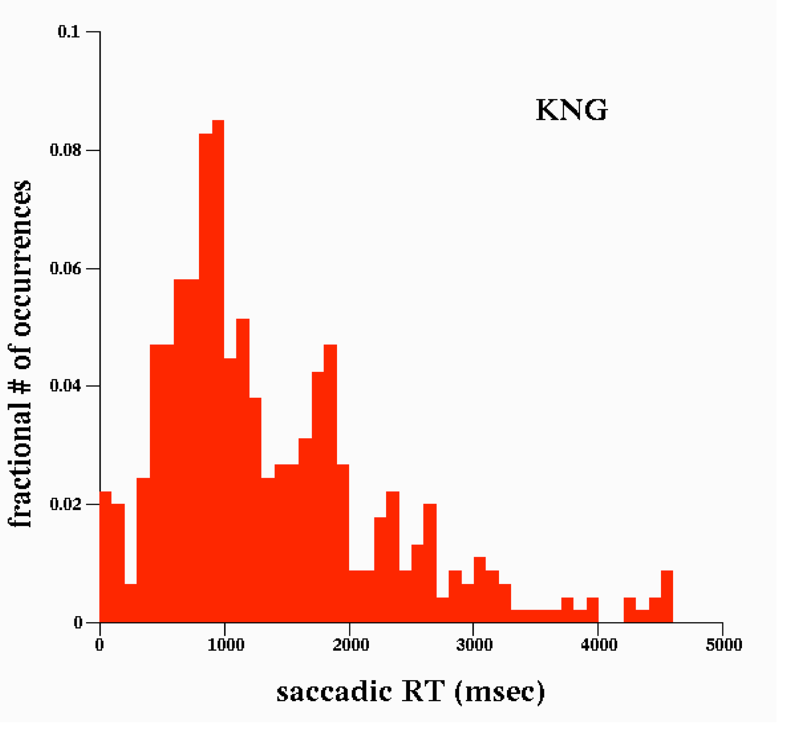
The subject's point-of-regard is estimated from video recordings, using in-house eye-tracking software.









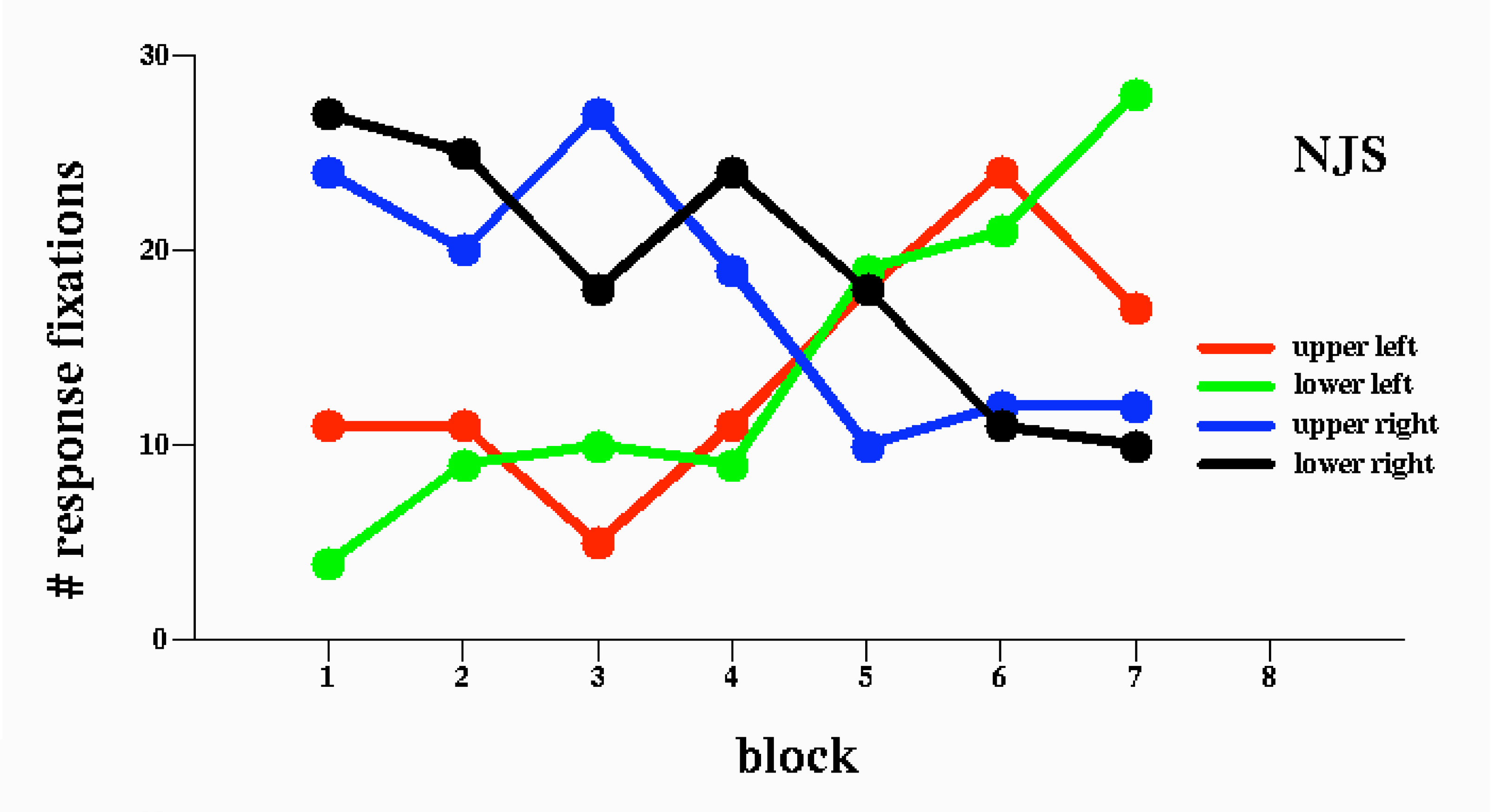


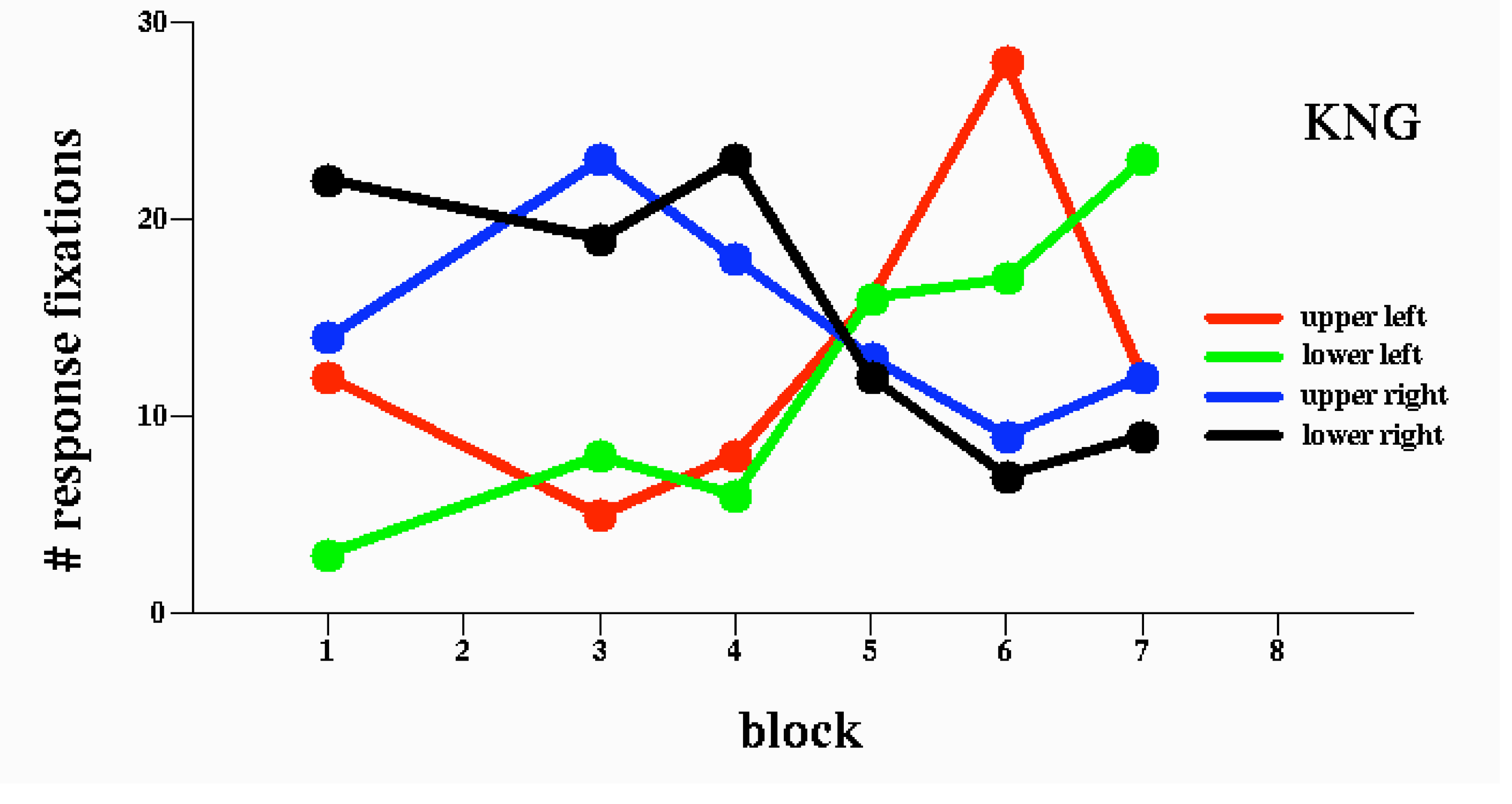
Two kinds of fixations to alerts

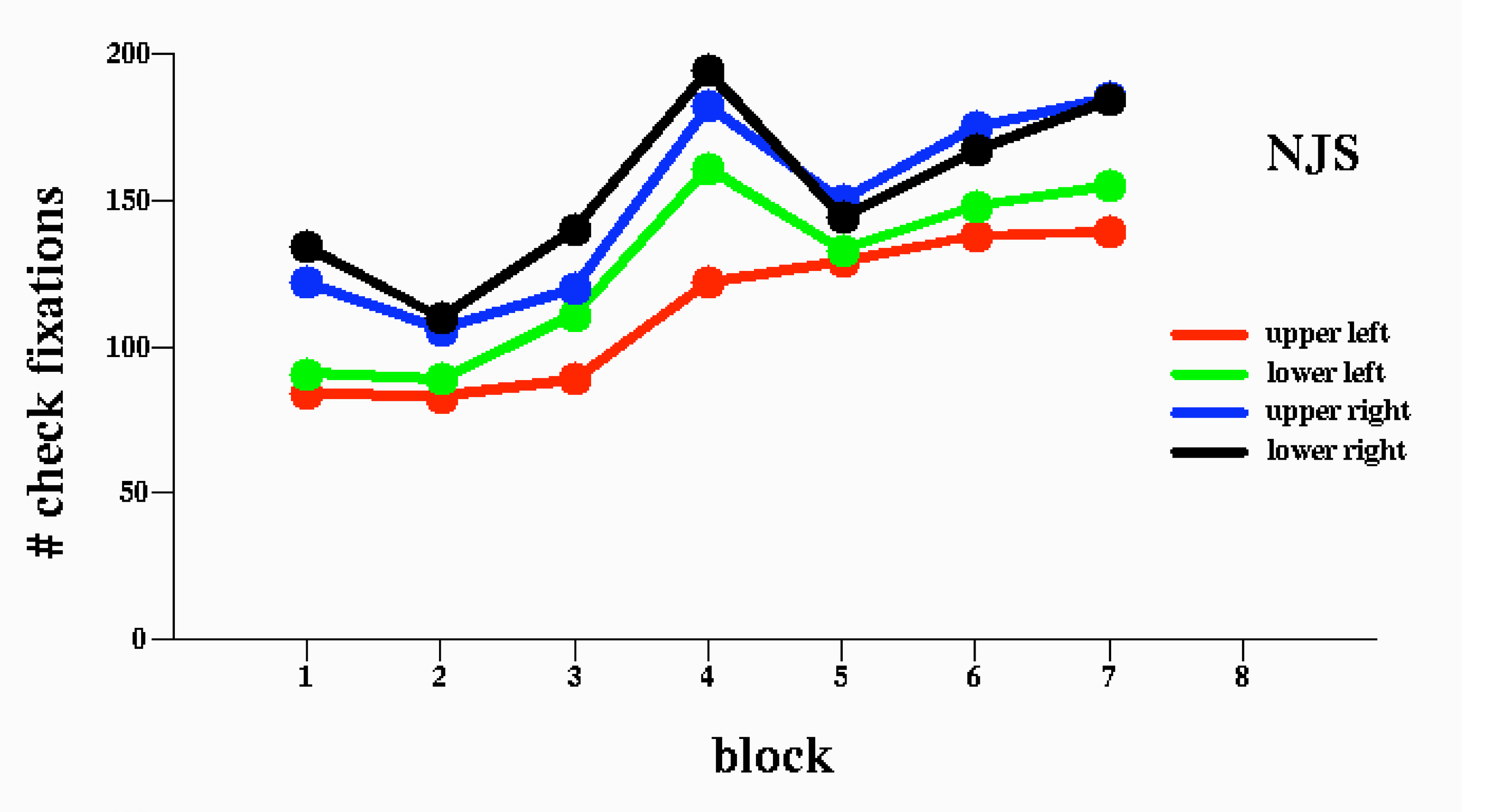
Because the subjects know that some alerts must be fixated to be seen, they make quick "check" fixations to the alert locations when the demands of the central task permit. These are characterized by relatively short durations (e.g. 200 msec). When an alert is detected, on the other hand, whether through peripheral vision or as the result of a check fixation, longer fixations are observed as the subject reads the value in the alert box, and guides the cursor to the response button. Interestingly, some shorter response fixations are also observed. (Response fixations are defined as fixations to an active alert which is followed by a cursor action.) These suggest that subjects may be executing a sequence of pre-programmed check fixations which cannot be interrupted even when an alert is detected.

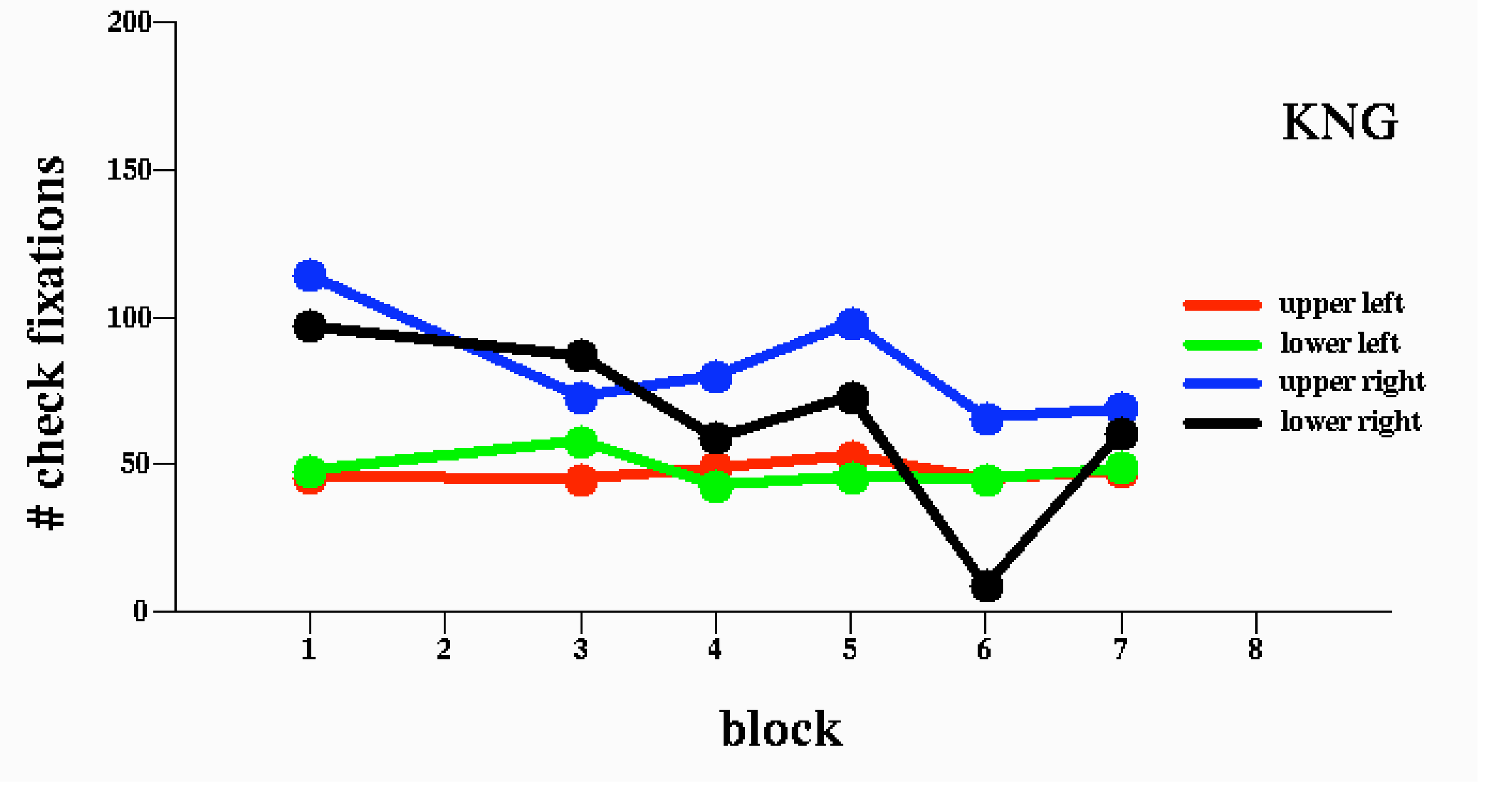
Long-tailed reaction time distributions

Saccadic reaction times (the time from the onset of an alert to a saccade to the alert region) are clustered around 1 second, which is the time needed to interrupt performance of the primary task and reorient to the alert region. The longer times probably correspond to check fixations made when a visible alert was present that was invisible in the periphery. The distributions do not vary much with stimulus level, but stimulus level effects may be washed out by the variability in gaze position and the relatively small number of trials.









Unequal alert probabilities

The experiment was constructed such that alerts occurred more frequently on the right in blocks 1-4, and more frequently on the left in blocks 5-8. Subjects seem to learn this, as seen in the plots on the right, where we see higher number of checking fixations to the right hand locations. When the probabilities change, however, at block 5, these subjects do not readjust their checking strategy, continuing to check the right side more frequently.

More checking with practice?

Subject NJS exhibits increasing numbers of checking fixations with increased familiarity with the task, while subject KNG's behavior is fairly constant. Practice on the primary task may cause it to be performed more efficiently, allowing more resources to be devoted to monitoring the alert locations.

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